Mine Production Management

Ben Farquharson:
Vice President GEOVIA, Asia Pacific South
Our Company

a Scientific company
Combining Science, Technology and Art for a sustainable society

13,300 passionate people
- 117 nationalities
- One global R&D / 56 labs
- Game changing 3DEXPERIENCE solutions

190,000 enterprise customers
- 12 industries in 140 countries
- >10 million on premise users
- >100 million online users

10,000 partners
- Software, Technology & Architecture
- Content & Online Services
- Sales
- Consulting & System Integrators
- Education
- Research

Long-term driven
- Majority shareholder control
- Revenue: $3.2 Bn*
- Operating margin: 29.8%*

* Figures as of FY 2014 / Non-IFRS
The Evolution of GEOVIA

1970's
Minex launched by ECSI

1982
Surpac launched

1985
Gemcom founded, spun off from SRK

1982
Surpac IPO on TSX

1997
Gemcom purchased Whittle Programming

2002
Surpac purchased ECSI, created Surpac Minex Group

2002
Gemcom purchased Surpac Minex Group

2006
Gemcom purchased Surpac Minex Group

2008
Gemcom taken private

2012
Dassault Systèmes purchased Gemcom, GEOVIA brand is launched targeting Natural Resources

Today

- 35-40% global market share
- >420 staff in 15 offices
- Customers in >4000 sites in >130 countries
- >10,000 licenses of Surpac in use, in >120 countries
GEOVIA – The Leading Mining Portfolio

EXPLORATION ▶ EVALUATION ▶ PLANNING ▶ ENGINEERING ▶ MINE PRODUCTION MANAGEMENT AND RECONCILIATION

SERVICES

GEOLOGY AND MINE PLANNING

**Surpac**

Surpac is the world’s most popular geology and mine planning software. It delivers efficiency and accuracy through ease-of-use, powerful 3D graphics and workflow automation.

**GEMS**

GEMS provides collaborative geology and mine planning capabilities that support cross-functional teams involved in exploration, modelling, mine design, long-term planning and production scheduling.

**Minex**

Minex provides the best geology and mine planning tools for coal and other stratified deposits, ensuring resources are evaluated accurately and mined efficiently.

BLOCK CAVING

**PCBC**

PCBC is used by virtually every major mining company involved in block caving, who rely on its comprehensive functionality to assist with feasibility studies, design and production management.

**Whittle**

Whittle is the world’s most trusted strategic mine planning software used to determine and optimise the economics of open pit mining projects.

SCHEDULING

**MineSched**

MineSched provides long- and short-term scheduling for surface and underground mines of all sizes and types, improving productivity and profits beyond what’s possible in manual scheduling.

MINE PRODUCTION MANAGEMENT AND RECONCILIATION

**inSite**

InSite collates progress of production activities against the plan. Advanced reconciliation tools allow mining operations to address and understand the cause of variance.

**Hub**

Hub provides secure remote collaboration that organises, centralises and enables the reliable sharing of exploration, planning, and production data over low-bandwidth connections.

SECURE REMOTE COLLABORATION

**Services**

When you don’t have the time or in-house resources available, GEOVIA’s global Services team can provide geology, engineering, and operations assistance.
What is GEOVIA InSite™

Introduction
What is GEOVIA InSite™

- Tracks the quality and quantity of materials across your operations
- Manages material stockpiles
- Built for the Mining Industry
- Full auditability
- Transactional database for all activities and movements in near real time
- Material Balance allows variances to be managed with more confidence
- InSite activities can have costs associated (equipment, personnel and consumables)
GEOVIA InSite™ Architecture

### Data Sources
- Geology, Mine Design, Scheduling
- Fleet Management, Dispatch
- ERP
- Data Historian
- Custom databases
- 3rd party sources
- Custom spreadsheets
- Manual data entry

### Integration layer – Validation and rules
- Activity Management
- Production Progress
- Material Balance
- Stockpile Management
- Calculation Engine
- Master Data Management
- Grade Control
- Equipment Performance
- Activity Based Costing

### Reporting Services
- Ad Hoc reports
- Scheduled Reports
- Dashboards

### Outputs
- GEOMETRY
- GEODESIC
- VBC
- SP²
- Other

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GEOVIA InSite

Conformance to Plan
Common problems with existing systems

- Time spent preparing data
- Data confidence
- Managing the discrepancy between claimed and actual
- Understanding where and why there are differences between forecast and actual, and actual and actual
Common Problems Manual Data Capture – Excel/Paper

- Data
  - Confidence
  - Validation
  - Accuracy
  - Document control

- Spreadsheets are common
  - Time
  - Sharing
  - Errors

“While people are about 95% to 98% accurate when they make spreadsheet cells entries, they are only about 50% to 80% successful when they attempt to detect if there is an error in a cell” [Panko, 2010b].

Offering an alternative

- A configurable software solution that can
  - Plan and allocate mining activities at shift level
  - Integrate with automated operations management data sources or collate data manually
  - Monitor current progress of any mining or production activity

- Advanced tools that
  - Compare plan against actual in near real-time
  - Analyse the variance
GEOVIA InSite
Conformance to Plan
Types of Data Acquisition

Automatic

Manual
Data Entry

- Replaces spreadsheets with fast and easy interface
- Record data when electronic data unavailable
- Accurate and validated data
Inspect and Correct

• Analysis tool to query data captured.
• Highlights any compromised validated data.
• Allows users to make the changes.
• All changes are audited including from & to values.
GEOVIA InSite

Production Inventory Accounting (PIA)
Production Inventory Accounting

Mining Problem

• Set up of complex algorithms difficult to maintain

• Is assay data entered accurately

• Reconciliation details not auditable

How InSite helps

• Accurate view of stockpile mass and grade

• Stockpiles updated with accurate surveyed volumes

• Confidence in data – Validation rules and manual data entry validated

• Quality provided Automatically or Manually

• Stockpile data linked with materials balance
• Stockpile management is required because:
  • To accurately report monthly mine production, material held in stocks must be accounted for
  • Plant performance requires predictable feed of ore at known tonnes and grade
• Tonnes in a stockpile is automatically calculated based on the sum of material movements.
• Grade is calculated using either FIFO, LIFO or weighted average
• Due to measurement inaccuracy, regular surveys are performed to adjust calculated stocks
Stockpile Management

- Confidence in reported tonnes and grades
- Integrates directly with materials balance
- Calibrate stockpiles with survey data whenever it is available
Stockpile Management

Stockpile Balances Report

- Provides a summary of balances and movement to and from stockpiles.
- Includes opening and closing balances for the selected period.
- Includes movements to and from the stockpile.
- Includes tonnes and grades.

### Stockpile Balances

**10/2013 to 31/07/2013**

<table>
<thead>
<tr>
<th>Stockpile</th>
<th>Material</th>
<th>Opening (t)</th>
<th>Input (t)</th>
<th>Output (t)</th>
<th>Closing (t)</th>
<th>Opening (oz)</th>
<th>Contained Gold</th>
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</thead>
<tbody>
<tr>
<td>Coarse Ore Stockpile</td>
<td>Ore</td>
<td>1,000</td>
<td></td>
<td></td>
<td>1,000</td>
<td>36.3</td>
<td>1.1</td>
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<td>Crusher</td>
<td>Ore</td>
<td>1,212</td>
<td>2,818</td>
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<td>3,230</td>
<td>42.4</td>
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<tr>
<td>Grizzly</td>
<td>Ore</td>
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<td></td>
<td></td>
<td>1,000</td>
<td>42.3</td>
<td>1.1</td>
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<tr>
<td>ROM</td>
<td>Oxide Super High Grade</td>
<td>1,931</td>
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<td>1,846</td>
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<td>87.9</td>
<td>1.1</td>
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<td>3,293</td>
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<td>52.3</td>
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<td></td>
<td>Oxide Medium Grade</td>
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<td></td>
<td>1,463</td>
<td>41.3</td>
<td>0.9</td>
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<td></td>
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<td>1,463</td>
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<td>26.6</td>
<td>0.4</td>
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<td>Fresh Super High Grade</td>
<td>1,399</td>
<td>1,083</td>
<td>1,083</td>
<td>1,083</td>
<td>55.4</td>
<td>1.3</td>
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<tr>
<td></td>
<td>Fresh High Grade</td>
<td>1,182</td>
<td>28</td>
<td>1,163</td>
<td>1,163</td>
<td>41.7</td>
<td>1.1</td>
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<td></td>
<td>Fresh Medium Grade</td>
<td>1,351</td>
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<td></td>
<td>1,351</td>
<td>36.1</td>
<td>0.9</td>
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<td>Fresh Low Grade</td>
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<td>1,351</td>
<td>19.1</td>
<td>0.4</td>
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<tr>
<td>Waste Dump</td>
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<td></td>
<td>2,925</td>
<td>10.3</td>
<td>0.1</td>
</tr>
</tbody>
</table>
Material Balance

- Reduce variance in planned vs actual
- Direct link with stockpile + production data
- Compare factors with reality, modify with evidence
In a mine production process, the same data is measured several times with different accuracy. Accounting for inaccuracy is a key concept in mine production management and reporting.

Measurements are typically more accurate later in the production process (in the plant).

Material balance divides the production process into “envelopes”. Material movements between envelopes must balance.

Material movements from more accurate envelopes will adjust measurements from less accurate envelopes so that they balance.
Daily Production Summary

Daily Production Summary

- Provides a summary of all information captured on a daily basis and structured by activity.
- Includes daily and month to date data.
- Includes planned and actual values and calculates variance from plan.
Material Flow Dashboard

• Provides a visual overview of the material moved.
• Includes daily data for hauling, crusher feed, crushing and plant feed.
• Includes planned and actual values and calculates variance from plan.
InSite Reporting

DAILY MINE PRODUCTION REPORT
Type Mine Operations
2/12/2014
Production Progress

- In shift view of production progress
- Graphical representation of task duration and production progress
- Allows information to be viewed and updated graphically.
Variance Analysis

- Graphically represent Plan vs. Actual per activity per shift
- View all Activities in one screen
- Track trend of plan versus actual to pickup trends
Integration Adaptor Configuration

Adaptor Configuration

• Easily to configure within the tool
• Changes can be made by authorised staff
• Allows new data to be mapped easily for integration and loading
Integration Monitor

- Easy to review the status of integrations
- Can be configured to alert specified staff
- Allows jobs to be resubmitted where appropriate
- Full history of integration runs

Integration Monitor

- 44 runs
  - Last run time: 03/02/2014 14:41:12
  - 70 Records Processed

- 2 runs
  - Last run time: 04/09/2014 11:00:54
  - 0 Records Processed

- 6147 runs
  - Last run time: 06/27/2014 14:07:00
  - 0 Records Processed

- 1051 runs
  - Last run time: 06/27/2014 14:00:09
  - 0 Records Processed
GEOVIA InSite

Asset Utilisation

3DEXPERIENCE®
Offering an alternative

- A configurable software solution that can
  - Integrate with automated operations management data sources
  - Collate data manually
- Reduce IP Risk
- Streamline EOM process through integration & reporting
Equipment Performance

- Increase production and equipment utilisation
- Understand equipment usage
- Historical analysis of equipment performance
Activity Based Costing

- Assign cost of equipment, employees and consumables
- Visibility into cost of operation and production
- Trends and changes can be monitored

### Equipment Cost

<table>
<thead>
<tr>
<th>Equipment</th>
<th>Hours</th>
<th>Rate ($/h)</th>
<th>Cost ($)</th>
<th>Hours</th>
<th>Rate ($/h)</th>
<th>Cost ($)</th>
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</thead>
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<td>Bulldozer</td>
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<td>404.154.37</td>
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<td>2,204.09</td>
<td>404.154.37</td>
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<td>57.00</td>
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<tr>
<td>D216</td>
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<td>20.171</td>
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<td>94.70</td>
<td>20.171</td>
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<tr>
<td>D217</td>
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<td>20.171</td>
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<tr>
<td>D218</td>
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<td>323.70</td>
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<td>20.171</td>
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<td>94.70</td>
<td>20.171</td>
<td></td>
</tr>
<tr>
<td>Dump Truck</td>
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<td>4,261,693.94</td>
<td>3,388.09</td>
<td>4,216,693.94</td>
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</table>

### Consumable Cost

<table>
<thead>
<tr>
<th>Consumable</th>
<th>Rate ($/Unit)</th>
<th>Units</th>
<th>Cost ($)</th>
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</thead>
<tbody>
<tr>
<td>Boosters</td>
<td>1.00</td>
<td>3,846.00</td>
<td>3,846.00</td>
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<tr>
<td>Explosives</td>
<td>1.00</td>
<td>545,643.00</td>
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<td>Fuel and Lubricants</td>
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<td>1,127,324.20</td>
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<tr>
<td>Total</td>
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<td></td>
<td>1,575,354.02</td>
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</table>
Key InSite Implementations
The Benefits of GEOVIA InSite

- Improved forecasting
  - Understand variance from plan and reforecast faster

- Improved efficiency
  - Free Geologists and Engineers from Excel and allow them to analyse in real-time
  - Manage consumables and unplanned down time

- Increased accuracy in reporting
  - Better data validation, reports & decisions made quicker

- Improved visibility into operations
  - Understand the cost of mining each ounce
  - See correlation between mining and plant production

- Centralising enables Activity level comparison between sites

- Standards
  - Supports Master Data Management
  - Consistent identification and measurement against best practise

- Provide a basis for continuous improvement
Live Demonstration

Contact us at; Dassault Systemes GEOVIA